REMARKS

Reconsideration and allowance of the present application, as amended, are respectfully requested.

Claims 1, 3-7, 15 and 16 stand rejected under 35 U.S.C.102(b) as being anticipated by Lee et al. Claim 7 stands rejected under 35 U.S.C.103(a) as being unpatentable over Lee et al. in view of Kajita. These grounds of separation are respectfully traversed.

Applicant appreciates the Examiner's indication of allowability of claim 2 and claims 8-14.

The Examiner noted, in Response to Arguments, that the nitrogen gas, which is used in Lee's exposing step, reads on the claimed gas.

In studying the specification of the present invention in the light of the remarks of the Examiner, Applicant has realized that there are errors which should be readily apparent to one skilled in the art to which the claimed inventions pertain. It was inadvertently stated that nitrogen is a reducing gas. For example, see page 10, lines 3-4.

It was the intention of the inventor to say that the nitrogen can be used together with a reducing gas. Similarly, page 11, line 14 lists nitrogen together with He and Ar as being a reducing gas. Here, NH_3 and H_2 are reducing gases, while N_2, He and Ar are inert gases.

In order to correct this obvious error, we have amended claims and the specification.

It is well known that nitrogen (and also He and Ar) is not a reducing gas.

Further, it is noted that page 5, lines 9-11 states in the original disclosure that "the first reducing gas may be any or more of silane, ammonia or hydrogen." Here, nitrogen is excluded from the list of reducing gases. We believe that this part also provides a support for the proposed Amendment.

Applicant believes that the Amendments presented herein are supported by the original disclosure and also by the knowledge commonly owned by those skilled in the art at the time the invention was made.

With claim 1 amended to exclude nitrogen as a reducing gas the rejection of claim 1 based on Lee et al. should be resolved.

In conformity with the amendment of claim 1, we have amended dependent claims 4, 5 and 11. Further, we have amended the Abstract of the Disclosure.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 4, third full paragraph:

Another object of the present invention is to provide a method for fabricating a semiconductor device, comprising the steps of:

forming a barrier conductor layer on a substrate;

exposing said barrier conductor layer to a first [reducing] gas atmosphere at an elevated substrate temperature;

forming, after said step of exposing said barrier conductor layer to said first [reducing] gas atmosphere, a metal film on said barrier conductor layer by a CVD process; and

exposing said metal film to a second [reducing] gas atmosphere at an elevated substrate temperature.

Page 5, second full paragraph:

According to the [present invention], inventions [the] adhesion between the barrier conductor layer and the metal film formed by the CVD process is improved substantially. [In the invention noted above, the] The first [reducing] gas may be any or more of a reducing gas such as silane, ammonia or hydrogen, while the second [reducing] gas may be any or more of hydrogen and nitrogen. The first and second exposing steps my be conducted at a substrate temperature of 250-500°C. It is preferable to use a monosilane SiH_4 for the silane source compound, which is generally represented as $Si_nH_2n_{+2}$. Further, it is preferable to conduct the

first exposing process at the temperature of 300-450°C and the second exposing process at the temperature of 300-400°C. Further, it is preferable to form the metal film by Cu and the barrier layer by Ta or TaN.

Page 5, third full paragraph:

Another object of the [present invention] inventions is to provide a method of fabricating a semiconductor device, comprising the steps of:

forming a barrier conductor layer of any of tungsten nitride or tantalum nitride on a substrate;

exposing said barrier conductor layer to a plasma of a reducing gas at an elevated temperature; and

forming, after said step of exposing said barrier conductor layer to said plasma, a metal conductor layer on said barrier conductor layer by a CVD process.

Page 6, first full paragraph:

According to the [present invention], inventions excellent blocking of element diffusion is achieved by using tungsten nitride or tantalum nitride for the barrier conductor layer. Further, adhesion between the barrier conductor layer and the metal film is improved. In the [present invention], claimed inventions the barrier conductor layer may be provided directly on the substrate or on an insulating film covering the surface of the substrate. Preferably, H_2 is used for the reducing gas. Further, it is preferable to conduct the plasma process at a temperature of 50-400°C, more preferably at a temperature of 100-250°C. In the present invention, it is further preferable to conduct an exposing step exposing the metal film to a [reducing] gas after the step of forming the metal film at an elevated temperature of 250-

500°C, more preferably at a temperature of 300-400°C. The metal film may be formed of a Cu film.

Page 6, second full paragraph:

Another object of the [present invention] inventions is to provide a method of fabricating a semiconductor device, comprising the steps of:

alternately and repeatedly forming,, on a substrate, and insulating film, a barrier conductor layer of any of tungsten nitride and tantalum nitride, and a metal film, said metal film being formed by a CVD process,

wherein a step of exposing said barrier conductor film to a plasma of a reducing gas at an elevated temperature is interposed between said step of forming said barrier conductor layer and said step of forming said metal film.

Page 9, third full paragraph:

Next, in the step of FIG.5 corresponding to the step S4 of FIG.1, the structure of FIG.4 is subjected to an annealing process conducted in a reducing gas atmosphere. Preferably, a silane (Si_nH2_{n+2}) gas, particularly a monosilane (SiH_4) gas, or an ammonia (NH_3) gas or a hydrogen gas (H_2) [or a nitrogen gas (N_2)] is used for the reducing gas, and the annealing process is conducted under a reduced pressure environment of about 40Pa at the temperature of 250-500°C, preferably 450°C, for a duration of about 3 minutes. During the annealing process, one or more of the foregoing reducing gases are supplied. In the case of using NH_3, the NH_3 gas is supplied with a flow-rate of 200 SCCM in the maximum, while in the case of using SiH_4, the SiH_4 gas is supplied with a flow-rate of 5SCCM in the maximum. In the case

of using H_2, the H_2 gas is supplied with a flow-rate of 500 SCCM in the maximum. Thereby, two or more gases may be mixed in the annealing process.

Page 11, second full paragraph:

Next, in the step of FIG.8 corresponding to the step S7 of FIG.1, the Cu layer 26 thus formed is then subjected to an annealing process conducted in a [reducing] atmosphere. More specifically, an atmosphere of any of NH_3, He, H_2, N_2 and Ar is used, and the annealing process is conducted under a pressure of at least 10 Pa at a temperature of 250-500°C for a duration of about 0.5 minutes more. For example, the annealing process may be conducted at 350°C over a duration of 5 minutes. The duration of the annealing process depends on the annealing temperature. When the annealing process is conducted at 350°, the H2 gas is supplied [as the reducing gas] with a flow-rate of 400 SCCM. It should be noted that the order of the foregoing steps S6 and S7 my be exchanged.

Page 13, third full paragraph:

Next, in the step of FIG.16 corresponding to the step S16 of FIG.10, the structure of FIG.15 is subjected to an annealing process conducted in a [reducing] gas atmosphere. In the step of FIG.16, an H_2 gas or an N_2 gas is used for the annealing atmosphere and the annealing is conducted under a reduced pressure of at least 10 Pa, preferably 670 Pa, at a temperature of 300-350°C over a duration of about 5 minutes while supplying the reducing gas with a flow-rate of 400 SCCM. It should be noted that the duration of the annealing process depends on the annealing temperature.

IN THE CLAIMS:

Please amend claims 1, 4, 5 and 11 to read as follows:

1. (Amended) A method for fabrication a semiconductor device, comprising the steps of:

forming a barrier conductor layer on a substrate;

exposing said barrier conductor layer to a first [reducing] gas atmosphere containing a reducing gas at an elevated substrate temperature;

forming, after said step of exposing said barrier conductor layer to said first [reducing] gas atmosphere, a metal film on said barrier conductor layer by a CVD process; and

exposing said metal film to a second [reducing] gas atmosphere at an elevated substrate temperature.

4. (Amended) A method as claimed in claim 1, wherein said second [reducing] gas atmosphere includes hydrogen [and] and/or nitrogen.

5. (Amended) A method as claimed in claim 1, wherein said step of exposing said metal film to said second [reducing] gas atmosphere is conducted at a temperature of 250-500°C.

11. (Amended) A method as claimed in claim 8, further comprising, after said step of forming said metal film, a thermal annealing process applied to said metal film.